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COMPARATIVE STUDY OF EXPERIMENTAL RESULTS ON THE WAVE-INDUCED LIQUEFACTION

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ABSTRACT

A series of model experiments were conducted to investigate the effects of the wave period and the thickness of permeable sandy bed layer on the wave-induced liquefaction, using a newly developed wave flume. In this study, the duration of the wave-induced liquefaction due to residual excess pore water pressure (residual wave-induced liquefaction) was compared with the experimental results observed by Suzuki et al. (2003). It could be found that, when the relative water depth under deepwater condition is about 0.11, the duration of the residual wave-induced liquefaction becomes the maximum.

KEY WORDS: Wave-induced liquefaction; Residual excess pore water pressure; Duration.

INTRODUCTION

The interaction among wave, seabed and marine structure is an important issue in geotechnical engineering, as well as coastal engineering.
The wave-induced pore water pressure has been considered to cause liquefaction in seabed. During a severe wave condition, wave pressures due to propagating waves generate wave-induced pore water pressures and cyclic shear stresses in the seabed. If cohesionless soils are saturated, excess pore water pressure may accumulate and lead to the liquefaction. The wave-induced liquefaction may result in the serious problems such as a failure of seabed, a floating of pipelines, and a settlement of rubble mound, because the liquefied seabed loses its shear strength.
There are two different mechanisms for the wave-induced liquefaction, namely residual and oscillatory liquefaction, depending on the way that excess pore water pressure is generated (Zen and Yamazaki, 1990). The former is caused by the residual nature of the excess pore water pressure, occurring after a certain number of cyclic waves, while the latter is generated by the oscillatory nature of the excess pore water pressure, which occurs periodically; a number of times during a storm sequence, responding to each wave.

There have been several studies on the wave-induced liquefaction through model experiments using the two-dimensional wave flume (Yamamoto et al., 1978; Takahashi et al., 1997; Suzuki et al., 2003; Kudella et al., 2006). In the case of using the existing wave flume, as shown in Table 1, the thickness of sandy bed layer is smaller than the depth of water in most of model experiments; therefore the thickness of sandy bed layer may have an effect on the results of model experiment.

Table 1 Conditions of model experiment on wave-induced liquefaction

		h/l	References
Depth of water h (m)	0.90	1.800	Yamamoto et al. (1978)
Thickness of sandy bed l (m)	0.50		
Depth of water h (m)	1.00	1.160	Takahashi et al. (1997)
Thickness of sandy bed l (m)	0.86		
Depth of water h (m)	4.50	1.125	Suzuki et al. (2003)
Thickness of sandy bed l (m)	4.00		
Depth of water h (m)	1.60	0.650	Kudella et al. (2006)
Thickness of sandy bed l (m)	2.45		

In order to consider the effect of thickness of sandy bed layer on the wave-induced liquefaction, a two-dimensional wave flume, of which the thickness of sandy bed is about three times deeper than the depth of water, was newly developed.
In addition, in order to satisfy the law of similarity in terms of time dimension a polymer solution was used instead of water. In the case of testing with a common wave flume, however, two-dimensional wave flume test under 1g conditions has a fundamental problem, not modeling the stresses of sandy bed correctly. Thus, scaled centrifuge model experiments have been conducted to eliminate the fundamental problem (Sassa and Sekiguchi, 1998).
Using the newly developed wave flume, a series of model experiments were conducted to investigate the effects of the wave period and the thickness of sandy bed layer on the wave-induced liquefaction. Wave-induced excess pore water pressure, displacements of markers installed in sandy bed layer and the duration of residual wave-induced